# User Manual

# 45K/60K Online UPS System

## Uninterruptible Power Supply System

**Please comply with all warnings and operating instructions in this manual strictly. Save this manual properly and read carefully the following instructions before installing the unit. Do not operate this unit before reading through all safety information and operating instructions carefully.**

# Table of Contents

**1. INTRODUCTION ..... 1**

1.1. PRODUCT MAJOR FEATURE ..... 1

1.2. PRODUCT OVERVIEW ..... 2

**2. INSTALLATION ..... 4**

2-1. SAFETY INSTRUCTION ..... 4

2-2. INSTALLATION ..... 4

**3. OPERATIONS ..... 6**

3-1. PARALLEL SYSTEM OPERATION ..... 6

3-2. REPLACEMENT ..... 7

3-3. DUAL MAINS INPUT (OPTIONAL) & MAINTENANCE BYPASS SWITCH OPERATION ..... 9

**4. SINGLE UPS BUTTON AND LCD OPERATION ..... 10**

4-1. BUTTON OPERATION ..... 10

4-2. LED INDICATORS AND LCD PANEL ..... 10

4-3. AUDIBLE ALARM ..... 12

4-4. FAULT CODE ..... 13

4-5. WARNING INDICATOR ..... 13

4.6. WARNING CODE REFERENCE ..... 13

**5. TROUBLE SHOOTING ..... 14**

**6. BATTERY MAINTENANCE ..... 15**

6-1. BATTERY MAINTENANCE & STORAGE ..... 15

6-2. IMPORTANT SAFETY CAUTION ..... 15

**6. SPECIFICATIONS ..... 16**

# 1. Introduction

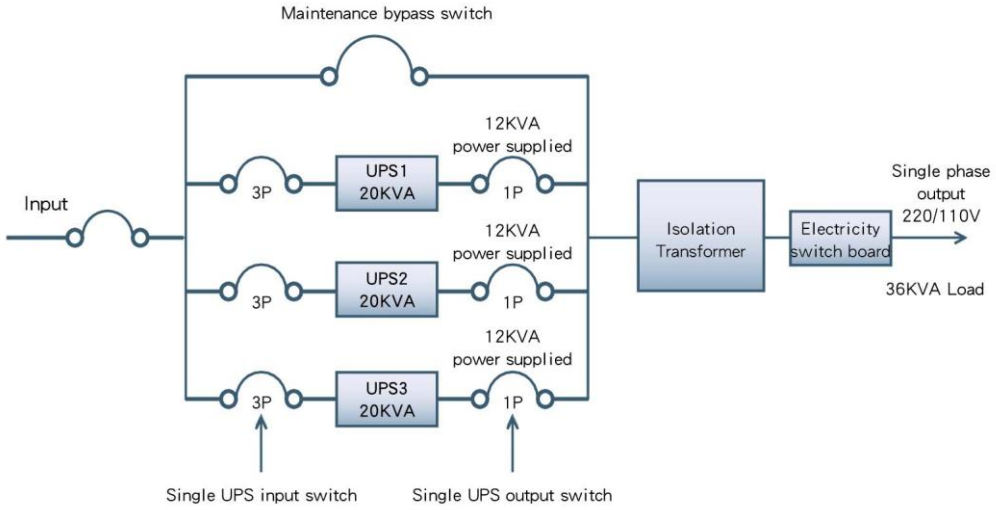
This modular redundant UPS system is entirely self-contained to allow each UPS module to work with complete functionality. Its modular design allows easy to service and upgrade with low cost MTTR. It also can be parallel operated with N+1 redundancy for power safety and reliability. This UPS system contains 3 sets of rack-independent online UPS modules, battery packs, and input/output transformer boxes. It's perfect power protection for server room, data center, telecom applications and mission-critical loads.

## 1.1. Product Major Feature

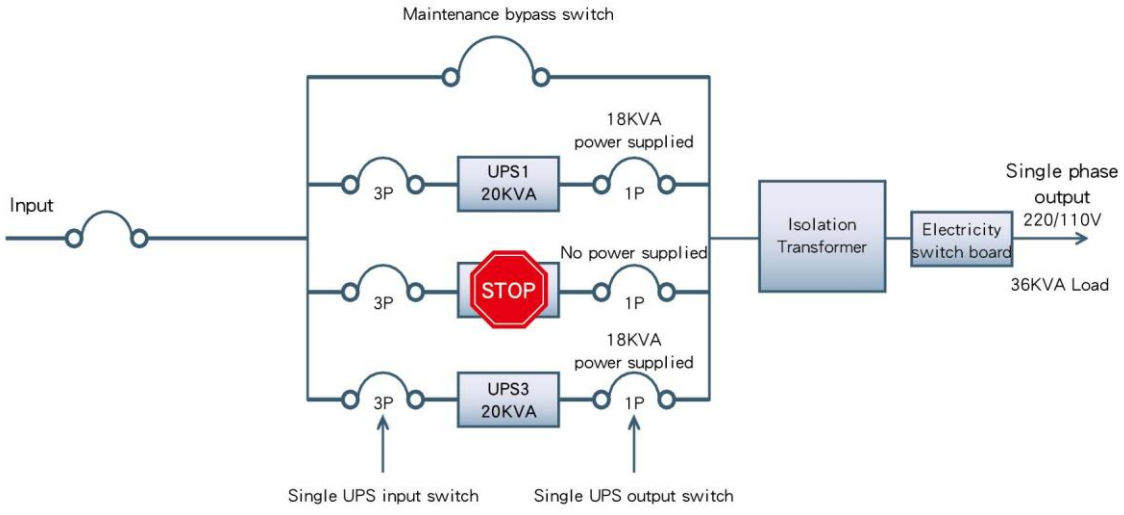
### N+1 parallel redundancy for power safety and reliability

N+1 technology allows a flexible adjustment of UPS power capacity all the time. Should any one UPS is malfunctioning, slave UPS will back up the load immediately. It increases power safety and reliability.

### Three UPS units supply power to 18KVA loads.




### When UPS 2 is not working, other UPSs will automatically supply power to the loads.



## 1.2. Product Overview

This whole UPS system already includes parallel distribution panels, UPS input/output, manually maintenance bypass switch, and isolation transformer. This chassis is specially designed for UPS system to withstand up to 800kgs.

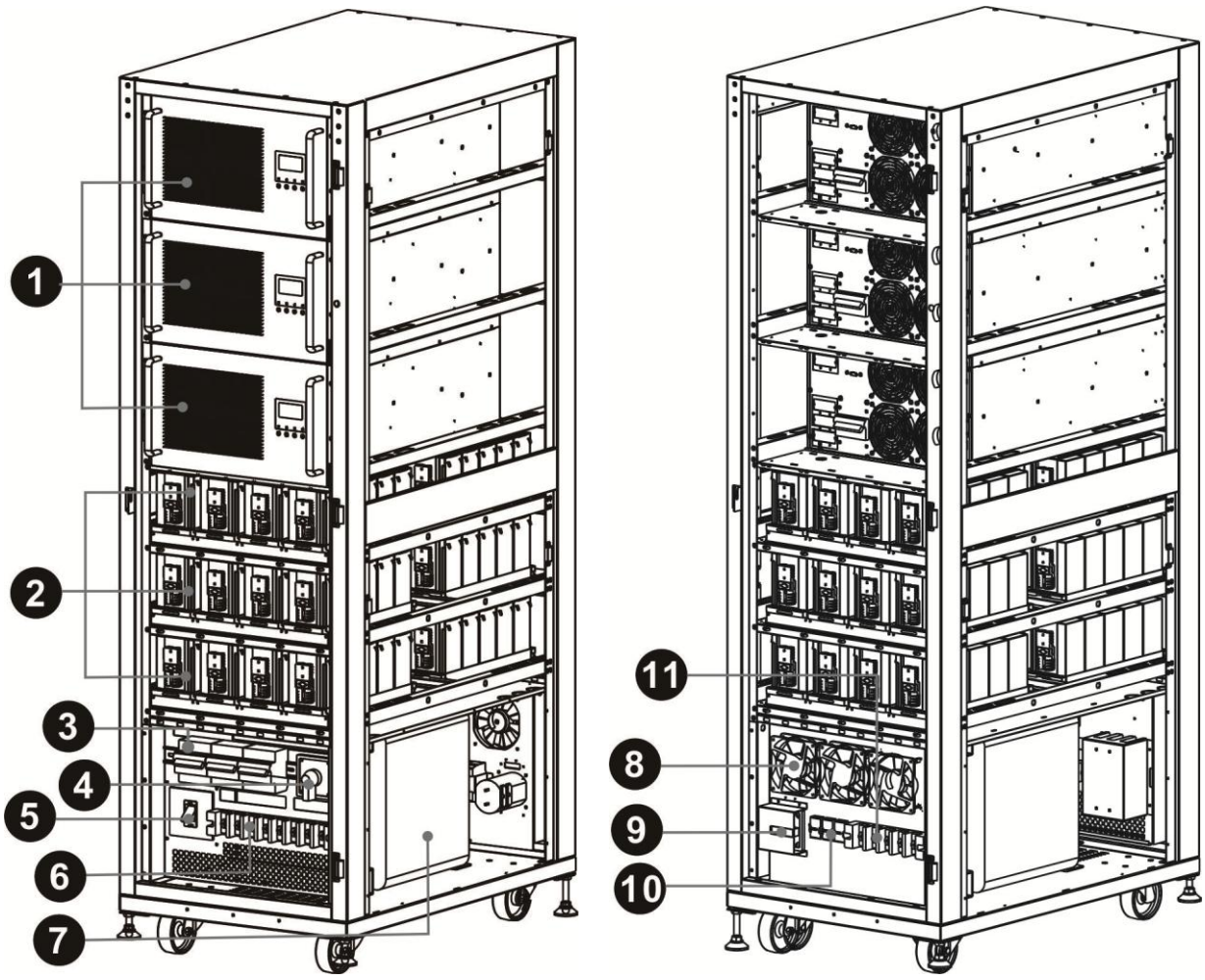



Figure 4: Inside view

1. Three-phase 20KVA UPS units
2. Battery packs (hot-swappable & dummyproof design)
3. Three input breakers for UPS system
4. Input switch for the utility
5. Input master switch
6. Input distribution panel
   Input: 3-phase 4-wire 380V/220V
7. Output isolation transformer
8. Cooling fan
9. Maintenance bypass switch
10. Three output breakers for UPS system
11. Output distribution panel
    Output: Single phase 3-wire 220V/110V

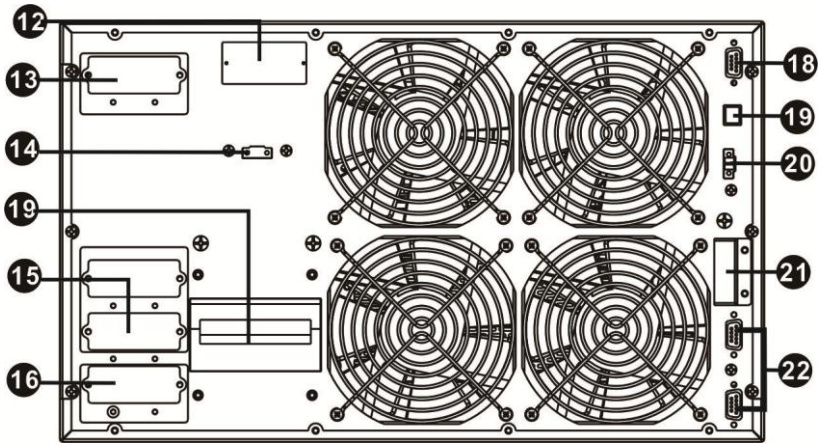



Figure 5: Single UPS back view

12. Intelligent slot
13. UPS output connector (Dummyproof design)
14. External maintenance bypass switch port (EMBS port)
15. UPS input connector (Dummyproof design)
16. Battery connector (Dummyproof design)
17. Input switch
18. RS-232 communication port
19. USB communication port
20. Emergency power off function connector (EPO connector)
21. Share current port
22. Parallel port

**CAUTION: Output connector is grey color, battery connector is red color, and input connector is blue color.**

Battery is applied with hot-swappable modular design to facilitate battery replacement easily.

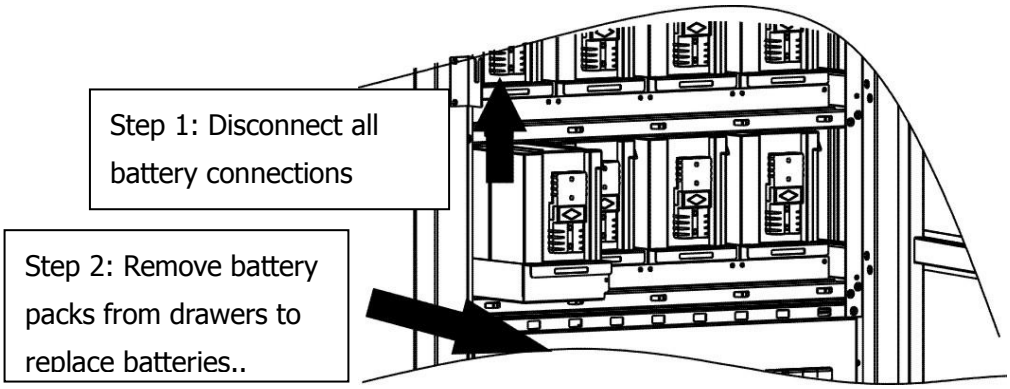



Figure 6: Hot-swappable battery design

# 2. Installation

## 2-1. Safety Instruction

1) The UPS must be installed in the room where it is ventilated and dry. Do not install the UPS system near water, flammable liquid, or corrosive substance.
2) Do not block ventilation holes in the UPS chassis. The UPS must be installed in a location with good ventilation. Ensure enough space (at least 0.5m) on each side for ventilation.
3) Condensation may occur if the UPS system is unpacked under cold environment. The UPS system must be absolutely dry before being installed. Otherwise, it may cause electric shocks. Please wait until the inside and outside of UPS system is absolutely dry.

## 2-2. Installation

Installation and wiring must be performed in accordance with the local electric laws/regulations and execute the following instructions by professional personnel. For safety consideration, please cut off the input utility power before installation. If connecting external batteries, please be sure to cut off battery connection first before installation.

1) Remove the back panel of UPS input/output distribution box.
2) Please use proper wires according to local electric laws/regulation and future expansion plan.

**CAUTION:** It's strongly recommended that the circuit is exclusively for UPS input, not shared with others. The input switch should withstand at least the maximum input current of the UPS.

3) Connect input and output wires on input and output terminals.

**CAUTION:** Be sure to connect all wires firmly.

4) Please connect two yellow/green wires. One wire is connected to grounding terminal on the UPS input distribution panel and the other wire is connected to grounding terminal of the loads.
5) Connect all input/output (dotted lines), battery (dotted line), parallel port (grey lines), EPO port (black lines), EMBS port (light grey lines), and share current port (black lines) on the back panel of each UPS unit. Refer to below figure.

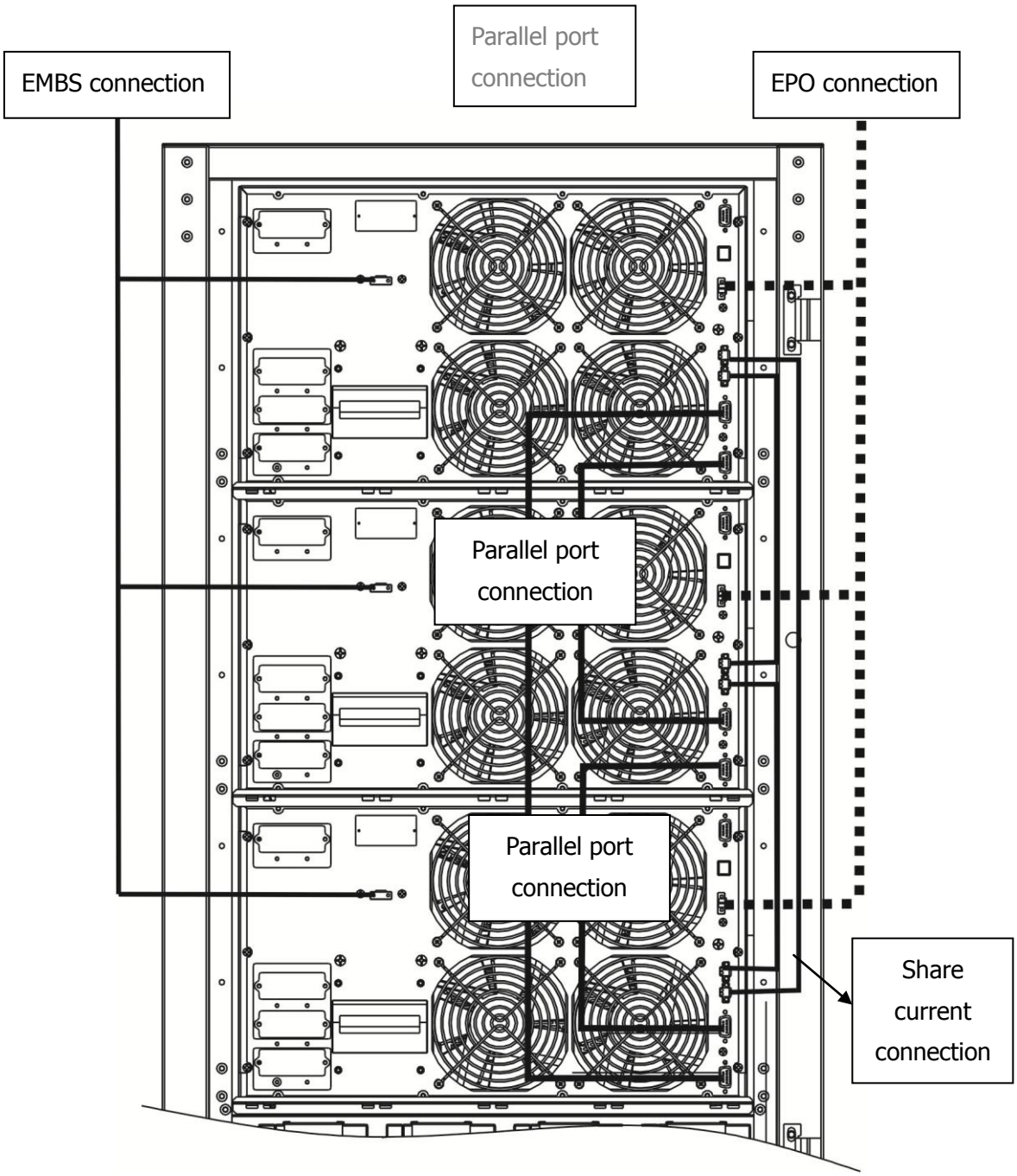



Figure 7: UPS connections

**CAUTION:** Share current cable is applied with red/black wire. EMBS cable is applied with black/black wire. EPO cable is applied with red/red wire.

6) After installation, please recheck if all cables/wires are connected correctly.

7) Before connecting loads to the UPS, be sure that UPS system and all loads are in "off" status.

8) No matter if the utility exists on UPS input or not, it may still contain electricity on UPS output even though shutting down the UPS system. Therefore, please be sure to turn off the UPS system and then cut off utility input. Then, there is no output from the UPS system.

9) After connecting all cables/wires and turning on the UPS system, this UPS will automatically charge battery. Please charge the battery at least 8 hours before initial use. If not, it still can work normally, but the backup time may be shorter than expected time.

10) When connecting inductive loads, it's requested to have big starting power. The starting power is 4 to 6 times of rated power. Please evaluate the UPS capacity based on starting power.

# 3. Operations

## 3-1. Parallel System Operation

**Turn On the System**

1) After all connections are properly installed, please turn "ON" UPS master switch and switch input breaker of all UPSs to "ON" status. Then, turn "ON" input switch of each UPS unit. The cooling fan will start to operate at the same time. All LEDs on front panels will light up. After initialization, only bypass LED will light up. Then, all UPSs will operate under bypass mode.
2) Please turn on each UPS one by one in one minute (press "ON" button for 1 second to turn on UPS). A few seconds later, all UPSs will enter to AC mode and LINE indicator on each UPS will light up. It will display "PAR 001~003" in order. The parallel system connection is complete. Then, turn on the output breaker of all UPSs.

   **CAUTION:** Before operation, please measure the voltage difference between the output line of each UPS with multimeter. Be sure that the output voltage difference should be less than 1V. If the difference is larger than 1V, please adjust inverter voltage via LCD operation. Please refer to single UPS manual for detailed LCD operation.

**Turn Off the System**

1) Turn off each UPS one by one in one minute (press "OFF" button for 1 second to turn off UPS). A few seconds later, all UPSs will transfer to bypass mode.

   **CAUTION:** If only removing one UPS, please press "OFF" button twice on the removing UPS and each time should last for more than 0.5s. Then, this UPS will enter into bypass mode without output. The other two UPSs will parallel operate normally.

2) Until now, there is bypass output from the UPS system. If shutting down output of this system completely, please turn off input breakers on back panel of each UPS, input master switch, and input breakers for all UPSs on the distribution panel. Then, this UPS will save all data and LCD panel will be still on at the same time. After a few seconds, the LCD display will shut off. This UPS system is completely off now.

   **CAUTION:** Be sure to wait until the UPS system is completely turned on and operated, then, turn on the power of connected load. Therefore, before shutting down UPS system, please turn off all power of connected loads first.

## 3-2. Replacement

**UPS Replacement**

Once any UPS is damaged, replacement can be completed in 10 minutes. Follow below steps to replace damaged UPS.

**Step 1:** Turn off input/output breakers of damaged UPS on distribution panel.

**Step 2:** Remove parallel cable, input/output cables, current share cable, EMBS cable, EPO cable, and battery cable from damaged UPS.

**Step 3:** Remove damaged UPS from the chassis.

**Step 4:** Replace with new UPS and connect all cables correctly. Turn "ON" the input breaker on new UPS unit and switch input and output breakers of new UPS on distribution panel to "ON" status.

**Step 5:** After pressing "ON" button for 1 second, the new UPS will start to operate with parallel system.

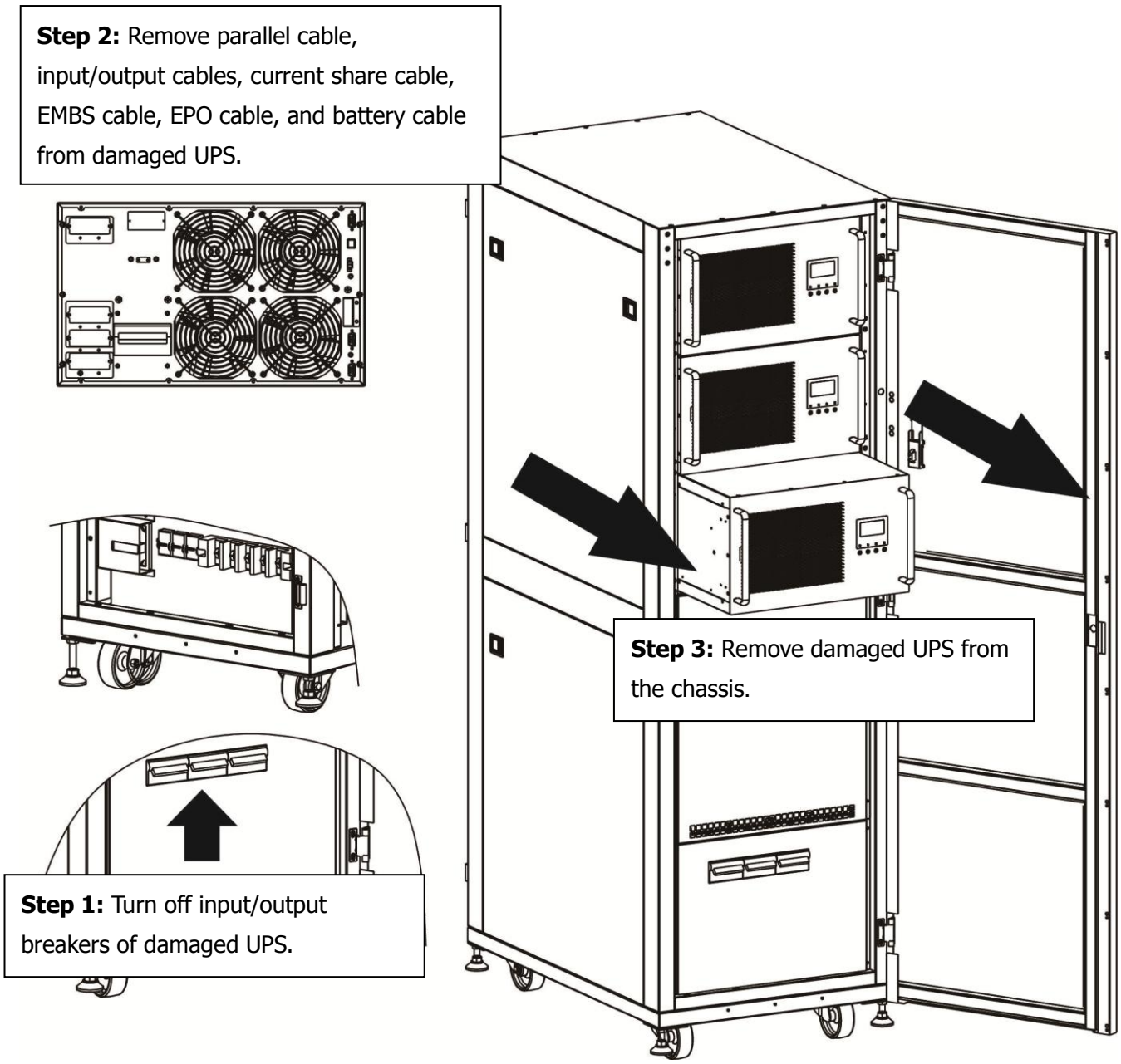

**Step 2:** Remove parallel cable, input/output cables, current share cable, EMBS cable, EPO cable, and battery cable from damaged UPS.
**Step 3:** Remove damaged UPS from the chassis.
**Step 1:** Turn off input/output breakers of damaged UPS.

Figure 8: Damaged UPS replacement

**Battery Replacement**

It's easy to replace bad batteries in 15 minutes even it's still under operation. Follow below steps to replace bad batteries.

**Step 1:** Unscrew 2 screws holding the battery retention plate and remove the plate.

**Step 2:** Remove all connected battery cables. (Paste insulated tapes in the end of battery cable to avoid short circuit)

**Step 3:** Pull out the battery drawer and replace bad batteries.

**Step 4:** Re-connect battery cables and re-assemble battery retention plate in reverse order.

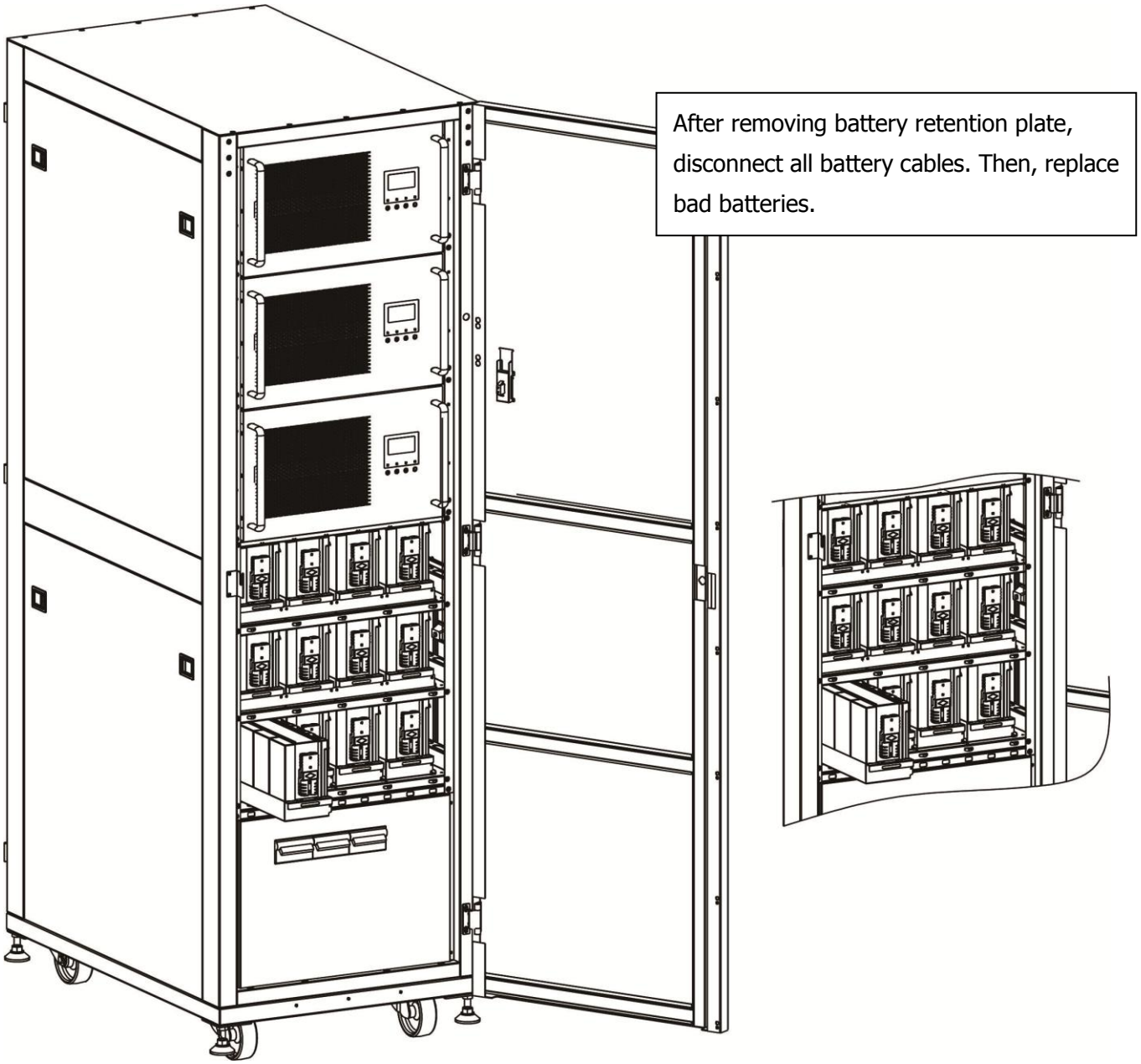



Figure 9: Battery replacement

## 3-3. Dual Mains Input (Optional) & Maintenance Bypass Switch Operation

**Dual mains input (Optional)**

This feature will allow this UPS system to accept dual mains inputs. It will switch the other power source when one input power fails. This second power source can be either power supply system or generator. This feature will provide higher reliability for power protection.

**Maintenance Bypass Switch**

When fault occurs on two or more UPSs, it's necessary to repair this UPS system. Please remove the maintenance bypass cover and set the maintenance switches from "UPS" to "BPS". This feature will allow UPS to operate in bypass mode so that all connected loads can still run without interruption.

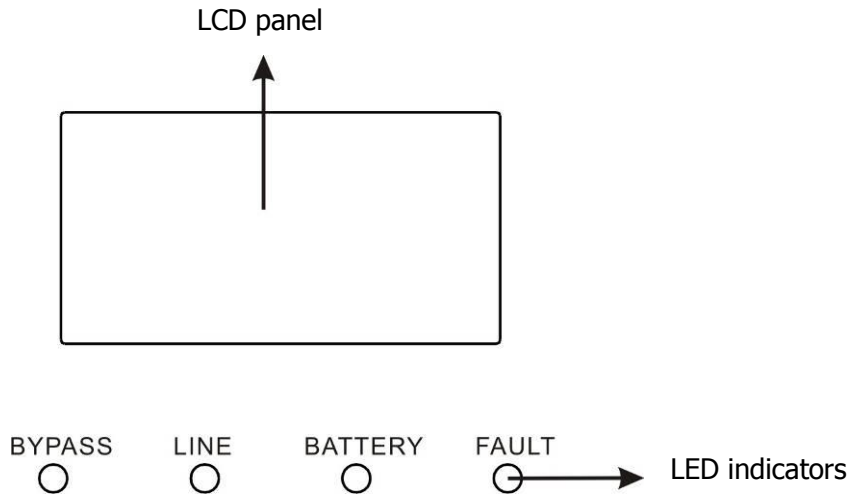
# 4. Single UPS Button and LCD Operation

## 4-1. Button Operation

| Button | Function |
|---|---|
| ON/Enter Button | ➢ Turn on the UPS: Press and hold the button more than 0.5s to turn on the UPS.<br>➢ Enter Key: Press this button to confirm the selection in setting menu. |
| OFF/ESC Button | ➢ Turn off the UPS: Press and hold the button more than 0.5s to turn off the UPS.<br>➢ Esc key: Press this button to return to last menu in setting menu. |
| Test/Up Button | ➢ Battery test: Press and hold the button more than 0.5s to test the battery while in AC mode, or CVCF mode.<br>➢ UP key: Press this button to display next selection in setting menu. |
| Mute/Down Button | ➢ Mute the alarm: Press and hold the button more than 0.5s to mute the buzzer. Please refer to section 3-4-9 for details.<br>➢ Down key: Press this button to display previous selection in setting menu. |
| Test/Up + Mute/Down Button | ➢ Press and hold the two buttons simultaneous more than 1s to enter/escape the setting menu. |

* CVCF mode means converter mode.

## 4-2. LED Indicators and LCD Panel



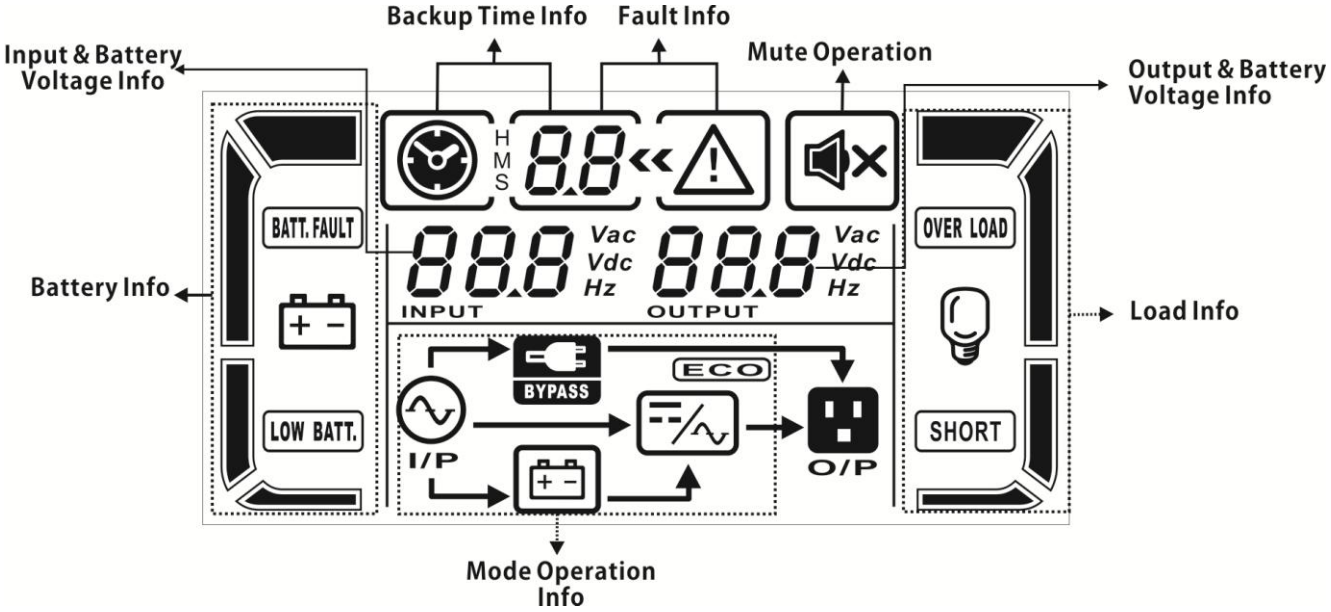

**LED Indicators:**

There are 4 LEDs on front panel to show the UPS working status:

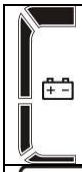
| Mode \ LED | Bypass | Line | Battery | Fault |
|---|---|---|---|---|
| UPS Startup | ● | ● | ● | ● |
| Bypass mode | ● | ○ | ○ | ○ |
| AC mode | ○ | ● | ○ | ○ |
| Battery mode | ○ | ○ | ● | ○ |
| CVCF mode | ○ | ● | ○ | ○ |
| Battery Test | ● | ● | ● | ○ |
| ECO mode | ● | ● | ○ | ○ |
| Fault | ○ | ○ | ○ | ● |

Note: ● means LED is lighting, and ○ means LED is faded.

**LCD Panel:**




| Display | Function |
|---|---|
| **Backup time information** | |
| H M S 88 | Indicates battery discharge time in numbers.<br>H: hours, M: minutes, S: seconds |
| **Fault information** | |
| « ⚠ | Indicates that the warning and fault occurs. |
| 88 | Indicates the fault codes, and the codes are listed in details in section 3-9. |
| **Mute operation** | |
| 🔇 | Indicates that the UPS alarm is disabled. |
| **Output & Battery voltage information** | |
| 888 Vac Vdc Hz OUTPUT | Indicates the output voltage, frequency or battery voltage.<br>Vac: output voltage, Vdc: battery voltage, Hz: frequency |
| **Load information** | |
| | Indicates the load level by 0-25%, 26-50%, 51-75%, and 76-100%. |
| OVER LOAD | Indicates overload. |
| SHORT | Indicates the load or the output is short. |
| **Mode operation information** | |
| I/P | Indicates the UPS connects to the mains. |
| + − | Indicates the battery is working. |
| BYPASS | Indicates the bypass circuit is working. |
| ECO | Indicates the ECO mode is enabled. |
| | Indicates the Inverter circuit is working. |
| O/P | Indicates the output is working. |
| **Battery information** | |

| | |
|---|---|
|  | Indicates the Battery capacity by 0-25%, 26-50%, 51-75%, and 76-100%. |
| BATT. FAULT | Indicates the battery is not connected. |
| LOW BATT. | Indicates low battery level and low battery voltage. |
| **Input & Battery voltage information** | |
| | Indicates the input voltage or frequency or battery voltage.<br>Vac: Input voltage, Vdc: battery voltage, Hz: input frequency |

## 4-3. Audible Alarm

| Description | Buzzer status | Muted |
|---|---|---|
| **UPS status** | | |
| Bypass mode | Beeping once every 2 minutes | Yes |
| Battery mode | Beeping once every 4 seconds | |
| Fault mode | Beeping continuously | |
| **Warning** | | |
| Overload | Beeping twice every second | No |
| Low battery | Beeping once every second | |
| Battery is not connected | | |
| Over charge | | |
| Fan failure/Over temperature | | |
| Charger failure | | |
| Battery fuse is broken | | |
| Input phase is not correct | | |
| Input fuse in L1 is broken | | |
| Input neutral wire is not connected | | |
| Inverter current is not balanced | | |
| Overload 3 times in 30min | | |
| Utility conditions are not consistent in parallel system | | |
| Bypass conditions are not consistent in parallel system | | |
| EPO status | | |
| Cover of maintain switch is open | | |
| Phase auto adapt is not working | | |
| **Fault** | | |
| Bus start failure | Beeping continuously | Yes |
| Bus over | | |
| Bus under | | |
| Bus unbalance | | |
| Inverter soft start failure | | |
| High Inverter voltage | | |
| Low Inverter voltage | | |
| Inverter output short circuited | | |
| Negative power fault | | |
| Battery SCR short circuited | | |
| Inverter relay short circuited | | |
| Parallel communication failure | | |
| Parallel output current unbalance | | |
| Over temperature | | |
| CPU communication failure | | |
| Overload | | |

## 4-4. Fault Code

| Fault event | Fault code | Icon | Fault event | Fault code | Icon |
|---|---|---|---|---|---|
| Bus start failure | 01 | None | Negative power fault | 1A | None |
| Bus over | 02 | None | Battery SCR short circuited | 21 | None |
| Bus under | 03 | None | Inverter relay short circuited | 24 | None |
| Bus unbalance | 04 | None | Battery fuse is broken in battery mode | 29 | None |
| Over current in converter | 06 | None | Parallel communication failure | 31 | None |
| Inverter soft start failure | 11 | None | Parallel output current unbalance | 36 | None |
| High Inverter voltage | 12 | None | Over temperature | 41 | None |
| Low Inverter voltage | 13 | None | Overload | 43 | OVER LOAD |
| Inverter output short circuited | 14 | SHORT | UPS model incorrect | 46 | None |

## 4-5. Warning Indicator

| Warning | Icon (flashing) | Alarm |
|---|---|---|
| Battery low | LOW BATT. | Beeping every second |
| Overload | OVER LOAD | Beeping twice every second |
| Battery is not connected | BATT. FAULT | Beeping every second |
| Over charge | | Beeping every second |
| EPO enable | EP | Beeping every second |
| Fan failure/Over temperature | | Beeping every second |
| Charger failure | | Beeping every second |
| I/P fuse broken | | Beeping every second |
| Overload 3 times in 30min | | Beeping every second |

## 4.6. Warning Code Reference

| Warning code | Warning event | Warning code | Warning event |
|---|---|---|---|
| 01 | Battery unconnected | 10 | L1 IP fuse broken |
| 02 | IP Neutral loss | 21 | Line situations are different in parallel system |
| 04 | IP phase abnormal | 22 | Bypass situations are different in parallel system |
| 07 | Over charge | 33 | Locked in bypass after overload 3 times in 30min |
| 08 | Low battery | 34 | Converter current unbalance |
| 09 | Overload | 35 | Battery fuse broken |
| 0A | Fan failure | 36 | Inverter inter-current unbalance |
| 0B | EPO enable | 3A | Cover of maintain switch is open |
| 0D | Over temperature | 3B | Phase auto adapt failure |
| 0E | Charger failure | 3C | Utility extremely unbalanced |
| | | 3D | Bypass unstable |

# 5. Trouble Shooting

If the UPS system does not operate correctly, please solve the problem by using the table below.

| Symptom | Possible cause | Remedy |
|---|---|---|
| No indication and alarm in the front display panel even though the mains is normal. | The AC input power is not connected well. | Check if input cable firmly connected to the mains. |
| The icon ⚠ and the warning code EP flash on LCD display and alarm beeps every second. | EPO function is enabled. | Set the circuit in closed position to disable EPO function. |
| The icon ⚠ and BATT. FAULT flash on LCD display and alarm beeps every second. | The external or internal battery is incorrectly connected. | Check if all batteries are connected well. |
| The icon ⚠ and OVER LOAD flash on LCD display and alarm beeps twice every second. | UPS is overload. | Remove excess loads from UPS output. |
| | UPS is overloaded. Devices connected to the UPS are fed directly by the electrical network via the Bypass. | Remove excess loads from UPS output. |
| | After repetitive overloads, the UPS is locked in the Bypass mode. Connected devices are fed directly by the mains. | Remove excess loads from UPS output first. Then shut down the UPS and restart it. |
| Fault code is shown as 43. The icon OVER LOAD lights on LCD display and alarm beeps continuously. | UPS is overload too long and becomes fault. Then UPS shut down automatically. | Remove excess loads from UPS output and restart it. |
| Fault code is shown as 14, the icon SHORT lights on LCD display, and alarm beeps continuously. | The UPS shut down automatically because short circuit occurs on the UPS output. | Check output wiring and if connected devices are in short circuit status. |
| Fault code is shown as 1, 2, 3, 4, 11, 12, 13, 14,1A, 21, 24, 29, 35, 36, 41, or 46 on LCD display and alarm beeps continuously. | A UPS internal fault has occurred. There are two possible results:<br>1. The load is still supplied, but directly from AC power via bypass.<br>2. The load is no longer supplied by power. | Contact your dealer. |
| Battery backup time is shorter than nominal value | Batteries are not fully charged | Charge the batteries for at least 7 hours and then check capacity. If the problem still persists, consult your dealer. |
| | Batteries defect | Contact your dealer to replace the battery. |
| The icon ⚠ and flash on LCD display and alarm beeps every second. | Fan is locked or not working; or the UPS temperature is too high. | Check fans and notify dealer. |

# 6. Battery Maintenance

## 6-1. Battery Maintenance & Storage

- This UPS is applied with maintenance-free sealed lead acid batteries. When this UPS is connected to the utility, it will automatically charge battery no matter this UPS is on or not. It also offers overcharge and over-discharge protection.
- Before storing this UPS for long-time period, charge the UPS every 4-6 months. Under environment with high temperature, please charge and discharge the UPS every 2 months. The charging duration should last at least 12 hours each time.
- It's usually 3-year lifecycle for battery when working in the temperature of 25°C. If battery is detected abnormal, be sure to replace it ASAP. Battery replacement should be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.
- When replacing the batteries, use the same number and type of batteries.
- Please replace all batteries in the same time and follow instructions from battery supplier. It's not recommended to replace single battery in a time.
- If UPS system seldom discharges battery, please discharge battery until UPS shuts down every 4-6 months and recharge battery at least 12 hours. Be sure to discharge battery with at least 50% loads connected.

## 6-2. Important Safety Caution

**Before servicing battery, please read following instructions first.**

Before servicing battery, please remove watches, rings, or other metal objects.

When replacing battery wires, please buy materials from original dealer to avoid a fire caused by heating wires.

Do not attempt to dispose of batteries by burning them. This could cause battery explosion. The batteries must be rightly deposed according to local regulation.

Do not open or destroy batteries. Escaping electrolyte can cause injury to the skin and eyes. It may be toxic.

Please avoid short circuit in the plus and minus pole of the battery. Otherwise, it will cause a fire or electric shock.

Verify that no voltage between the battery terminals and the ground is present before maintenance or repair. In this product, the battery circuit is not isolated from the input voltage. Hazardous voltages may occur between the battery terminals and the ground.

Even after the unit is disconnected from the mains, components inside the UPS system are still connected to the battery packs which are potentially dangerous. The battery supply should be therefore disconnected in the plus and minus pole at the quick connectors of the battery when maintenance or service work inside the UPS is necessary.

The UPS system operates with hazardous voltages. Repairs may be carried out only by qualified maintenance personnel.

# 6. Specifications

| **MODEL** | | **Ensure 3/1 45K** | **Ensure 3/1 60K** |
|---|---|---|---|
| **TOTAL CAPACITY** | | 45KVA | 60KVA |
| **UPS UNITS** | | 3 x 3P/1P 15KVA | 3 x 3P/1P 20KVA |
| **TOPOLOGY** | | True Double-Conversion Online with 2+1 Parallel Redundancy Design | |
| **INPUT** | | | |
| Input Voltage | | 380/220 VAC 3 Φ4w or 220 VAC 1Φ2w | |
| Frequency Range | | 46 Hz ~ 54 Hz or 56 Hz ~ 64 Hz | |
| Power Factor | | ≧ 0.99 at 100% Load | |
| **OUTPUT** | | | |
| Output voltage | | 1Φ2w×2 groups with output transformer, 104/208 VAC or 110/220 VAC or 115/230 VAC or 120/240 VAC | |
| AC Voltage Regulation | | ± 1% | |
| Frequency Range (Synchronized Range) | | 46 Hz ~ 54 Hz or 56 Hz ~ 64 Hz | |
| Frequency Range (Batt. Mode) | | 50 Hz ± 0.1 Hz or 60Hz ± 0.1 Hz | |
| Overload | AC mode | 100%~105%: 10min 105%~115%: 1min >115% : 1sec | |
| | Battery mode | 100%~105%: 30sec 105%~115%: 10sec >115% : 1sec | |
| Current Crest Ratio | | 3:1 max | |
| Harmonic Distortion | | ≦ 3 % @ 100% Linear Load; ≦10 % @ 100% Non-linear Load | |
| Transfer Time | Line ⟷ Battery | 0 ms | |
| | Inverter ⟷ Bypass | 0 ms | |
| | Inverter ⟷ ECO | <10 ms | |
| **EFFICIENCY** | | | |
| Single UPS | AC mode | > 82% | |
| | Battery Mode | > 81% | |
| **BATTERY** | | | |
| Type & Numbers | | 12 V / 9 Ah x 20pcs x 2 sets / Per UPS Module | |
| Recharge Time | | 3-4 hours recover to 90% capacity | |
| Charging Current | | 2 A ± 10% (max.) | |
| Charging Voltage | | 273VDC ± 1% | |
| **PHYSICAL** | | | |
| **Single UPS** | Dimension, DXWXH(mm) | 668 x 438 x 266 [6U] | |
| | Net Weight (kgs) | 45 | 45 |
| **Whole System** | Dimension, DXWXH(mm) | 860 x 560 x 1870 | |
| | Net Weight (kgs) | 660 | 660 |
| **ENVIRONMENT** | | | |
| Operation Temperature | | 0 ~ 40°C (the battery life will down when > 25°C) | |
| Operation Humidity | | <95 % and non-condensing | |
| Operation Altitude** | | <1000m | |
| Acoustic Noise Level | | Less than 60dB @ 1 Meter (For UPS Module) | |
| **MANAGEMENT** | | | |
| Smart RS-232 or USB | | Supports Windows® 2000/2003/XP/Vista/2008/7/8, Linux, Unix, and MAC | |
| Optional SNMP | | Power management from SNMP manager and web browser | |

*Product specifications are subject to change without further notice.